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# Analysis of decision making in the acquisition of technology.

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# THESIS

**ANALYSIS OF DECISION MAKING IN THE ACQUISITION OF TECHNOLOGY**

by

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June 1997

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# ANALYSIS OF DECISION MAKING IN THE ACQUISITION OF TECHNOLOGY

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requirements for the degree of

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# ABSTRACT



This research effort examines decision making involving technology acquisition in large organizations. Senior managers manage a considerable amount of resources. Many of these resources are committed by senior managers to technology and the technology acquisition process. Resource constraints dictate that senior managers commit resources to technologies that ensure an organization's ability to remain relevant as a manufacturer or service provider. Senior managers are responsible for the decisions that ensure effective employment of limited resources. A clearer understanding of the decision making process and the models available to decision makers will potentially assist other senior managers in making decisions related to technology acquisition.

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# I. INTRODUCTION

## A. PURPOSE

This research examines decision making processes involving technology acquisition within large organizations. The importance of this research is based on two inextricably linked management considerations. First, the considerable amount of resources, committed by senior managers to technology and the technology acquisition process require some generally accepted decision making methodologies for process validation. Second, in view of limited resources, it is critical for a senior manager to commit those limited resources to technologies that ensure an organization's ability to remain relevant as a manufacturer or service provider. Senior managers are responsible for the decisions that ensure effective employment of limited resources. A clearer understanding of the decision making process and the tools available to decision makers potentially will assist other senior managers in making decisions related to technology acquisition.

Currently, Department of Defense (DoD) organizations as well as private institutions are experiencing significant changes as a result of the acquisition of new technology. Because technology can be represented by new work processes as well as various hardware and software, it is important to understand the context in which the word "technology" is being used. Technology is defined in the New College Edition of the American Heritage Dictionary as "the application of science, especially to industrial or commercial objectives." This definition continues, to include, "the entire body of methods and materials used to achieve such objectives."

New processes and new technologies are often inextricably linked. The discovery of nylon in the 1930s was a major technology innovation which created several by-products including plastics and synthetic fibers. In addition to the new products, new machinery was developed for manufacturing and new work processes were designed to assist in production. This example and the preceding definition illustrate how technology acquisition can have considerable impact on any organization.

Within both the DoD and commercial sector, the capital investment in technology has increased substantially. As indicated in Figure 1-1, significant increases in technology investment have occurred during the past twelve years. This trend in spending on technology is expected to continue. The Electronic Industries Association (EIA) predicts that spending on core defense information infrastructure is expected to run at least $5 billion annually between now and 2001 [Ref. 2: p. 38].

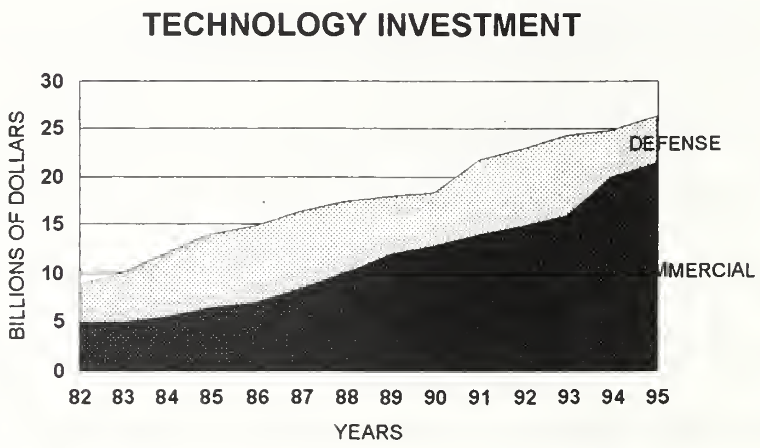


**Figure 1-1**. Information Technology Leads Investment [Ref. 1-1: p. 23]

As an example of technology investment, a substantial component of DoD's spending on technology is represented in the implementation of the Army's Force XXI initiatives. Force XXI serves as an example of an organization's resource investment in technology acquisition.

The Force XXI concept lays the foundation for the 21st century Army. Force XXI represents a re-engineering of the Army by introducing new technologies that will facilitate land force dominance in the information age. Not unlike private and commercial organizations, the technology acquisitions planned for Force XXI represent tools and basic material to help the Army of the 21st century to remain a relevant organization. Within the Army's Force XXI concept, the word "technology" is being applied to the hardware and software acquisitions related to the Army's movement toward Force XXI.

## B. BACKGROUND

There are numerous benefits from an organization's acquisition of a new technology. In the private sector the key benefits focus on achieving market leadership or desired market positioning. Market leadership or market positioning can be obtained by product differentiation achieved from an innovative manufacturing or service process that produces a higher quality product. Or, an organization can gain market leadership or position by using a new cost savings process that reduces overall product or service cost. In the public sector, the benefits of technology acquisition focus on conservation of resources and improving existing processes and equipment. In both cases the decision maker's motivation to acquire a technology is based on a need to meet an organization's stated objectives.

Unfortunately, in addition to the expected benefits, there are risks and negative impacts associated with technology acquisition. Often, considerable resources are expended for a new technology that fails to meet the expectations of the senior management. Major technology acquisitions can also cause a tremendous drain on limited resources and even contribute to an organization failing to achieve stated objectives. To help avoid or mitigate costly and often catastrophic failures, a senior manager's decision on the acquisition of technology should be based on a comprehensive analysis of the organization's goals, work processes, labor force, strengths, weaknesses, available capital and numerous other factors. Senior managers' concern over the risk associated with technology acquisition is evident in private and public organizations. Organizations in both sectors are investing considerable resources to acquire various technologies.

As an example of the military's technology acquisition pursuits, Force XXI technologies are defined and acquired under the broad umbrella of battlefield digitization. Proponents of the concept state that the acquisition of battlefield digitization will "allow commanders, staff and soldiers at various echelons to maintain a clear, accurate and appropriate picture of the battlespace, using a common data base, and to operate with a shortened decision cycle. It will also provide warfighters and supporters with relevant, real-time information which allows them to more effectively conduct operations" [Ref. 3: p. 7]. Unfortunately, like other technology acquisitions, senior managers and leaders responsible for Force XXI technology acquisition may overlook the secondary or unintended effects of introducing new technologies such as increased personnel issues, increased training and unforeseen implementation costs.

The following statement illustrates how one manager involved in the Army's acquisition process failed to address the interaction of new technology with the various components of the organization. "In terms of technology, digitization depends upon the effective integration of computer processing, advanced software, displays, man-machine interfaces, sensors, communications, combat identification, and position/navigation components" [Ref. 3: p. 8]. This statement reveals a manager who has failed to consider how technology interacts with personnel, systems processes, organizational structure and other components of the organization. It is my contention that a more encompassing or systems thinking approach to viewing the technology as an integral part of the organization can improve the success of the technology's implementation.

## C. RESEARCH OBJECTIVES

### 1. Primary Research Question

How do senior managers make decisions related to the acquisition of technology?

a. How do senior managers conduct needs assessments?

b. How do decision makers select technology that is appropriate for the organization?

c. How do senior managers anticipate the various effects of a given technology on the components of an organization?

### 2. Secondary Research Question

Can a more comprehensive model be developed that assists senior managers and improves decision making in the acquisition of technology?

## D. DISCUSSION

Many organizations are consistently upgrading or implementing new technologies. Often, decisions to acquire new technologies are made without fully recognizing the impact on the entire organization. More importantly, current and predicted budget constraints dictate that current decisions concerning the acquisition of new technology can have long term effects on an organization. A model that assists senior managers in assessing the effects of a particular technology will provide an invaluable resource.

My experience indicates that technology acquisition is often haphazard and not associated with specific organizational objectives. Cost and benefit analysis is often used to assess the validity of a technology acquisition decision. Although this type of analysis provides quantifiable data for decision makers, it fails to address all of the potential ramifications of a technology acquisition. Newspapers, magazines and other publications are filled with narratives about organizational problems that resulted from poorly planned technology acquisitions. Research that identifies substantive issues in the decision making process related to technology acquisition can potentially benefit future senior managers.

## E. SCOPE, LIMITATIONS AND ASSUMPTIONS

The main thrust of the research is the development of a model or tool to assist decision makers in making more informed decisions related to technological change. This is not a study of cost benefit analysis or technology implementation techniques. There is substantial literature available to support both implementation and resource tradeoffs computations. Additionally, this research will not focus on decision making in terms of a cognitive science. Again, there is significant research that addresses decision making in a general context. The intent of this study is to examine which organizational factors are

pertinent to decisions concerning the acquisition of new technology. More specifically, this research will consider which factors are often omitted by senior managers when decisions concerning technology acquisition are implemented.

## F. METHODOLOGY

This study's methodology focuses on the analysis of an organization's specific technology acquisition in the form of a multi-node management information system case study. The case is presented and analyzed using quantitative and qualitative data from decisions related to technology acquisition and decision making at the North Atlantic Treaty Organization's (NATO) military headquarters. This organization was selected because of the researcher's knowledge of the key participants, the senior manager's decision making process, the general environment and the final outcome of the case. Additionally, the case provides a vehicle to specifically address the two research questions stated earlier and serves as a reference for the development and analysis of a decision making model.

Additional research data also were collected. Interviews were conducted with eight individuals by phone, in person or through e-mail correspondence. The individuals interviewed include management information officers, administrative personnel, information security specialists, staff officers and senior managers at Supreme Headquarters Allied Powers Europe (SHAPE). Interviewees were selected based on their specific involvement in the acquisition of information technology at SHAPE. Additionally, a significant amount of information related to the case was based on the researcher's experience as a staff officer assigned to SHAPE as a software engineer working on a series of technology acquisitions.

## G. ORGANIZATION

Chapter II of this study provides an introduction to decision making models generally applied to technology acquisition. Two methods are discussed in this chapter. An overview of a rational approach to decision making is provided and second, a bounded or constrained approach to structured decision making is summarized.

Chapter III introduces SHAPE and provides background on a recent technology acquisition. This chapter also provides information on current decision making processes used specifically in the SHAPE technology acquisition.

Chapter IV provides a detailed analysis of the decision making approach and key issues surrounding the effects of the acquisition decisions in the SHAPE MIS case.

Chapter V introduces a model that can be used by decision makers that incorporates the organization's structure, work processes and other factors relative to technology acquisition. This chapter also applies the new model to the technology acquisition at SHAPE. The chapter concludes with an analysis of the applicability of the new model and an assessment of its effectiveness.

Chapter VI summarizes the findings of the research, answers the research questions and presents recommendations for further research and study.

## H. BENEFITS OF STUDY

The results of the thesis could potentially affect all organizations within the Department of Defense. Decision making surrounding technological acquisition is extremely relevant. Information technology is currently improving in cycles of less than eighteen months. The cost and other less obvious impacts on an organization that attempts to implement numerous technology changes can be significant. More importantly, the long

term ramifications of decisions related to technology acquisition can determine the viability and relevance of an organization. It is hoped that this research and the new technology acquisition model it introduces might assist senior managers in making more informed decisions about technology acquisition.

# II. DECISION MAKING

## A. INTRODUCTION

The desire of senior managers within both the Department of Defense (DoD) and the commercial sector to gain efficiency and remain competitive has led to a tremendous growth in technology acquisition. During the past fifteen years, a substantial amount of academic research has focused on the reasons why various technology acquisitions often fail to meet both the proponent's and users' full expectations [Ref. 4: pp. 51-56]. Current literature on acquiring new technology focuses on two major areas: Requirements Analysis and Process Re-engineering. These two areas represent major areas of research on how organizations assess their technology needs and implement internal change. However, limited research is dedicated to the specific processes used in decision making related to technology acquisition.

This chapter provides both the definitions and general application of two models currently used by organizations to describe the decision making process. Each model offers the user a structured approach to determining requirements. The first is the Rational Decision Making Model and the second is the Behavioral Decision Making Model. Although the focus of this research is not decision making theory, these models are presented to assist the reader in thinking about the decision making process. A subsequent chapter will address how those models are applied in making decisions related to technology acquisition.

## B. TYPES OF DECISIONS

Decisions involve making choices from alternatives. Even choosing not to do something is a decision involving alternatives. The literature characterizes two types of decisions: programmed decisions and non-programmed decisions [Ref. 5]. A programmed decision occurs when certain conditions exist that make the decision making process fairly routine. It also is one that occurs frequently enough for the organization to develop standardized rules in order to assist in making the decision. In most cases these rules take the form of guidelines and standard operating procedures. An example of this type of decision is found in the process of ordering spare parts for the Army's fleet of tactical vehicles. When a certain quantity of vehicles exists, the managers responsible for the supply system make a decision to store a given number of parts in the inventory. In the case of spares, decisions to order or to cancel orders for spare parts are made at lower levels of management within the organization. Even strategic decisions, made by senior leaders and managers within DoD, can be programmed. Using the same example, an annual review by senior managers of the required inventory requirements, stockage levels or funding for spare parts can be made using the same process discussed for ordering parts at the tactical level.

Non-programmed decisions are fairly unstructured and can potentially cause the most disruption in organizations. Non-programmed decisions are those that require significant research and analysis or intuition on the part of the decision maker. Because the decision is non-routine, there is little historical data on which the decision maker can base his or her decision. It is the non-programmed type of decisions that senior managers often must address in the acquisition of technology.

In the private sector, most non-programmed decisions related to the acquisition of technology result because of the need to remain competitive or achieve a new level of competitiveness. In the public sector, non-programmed decisions are often the result of innovations in processes or in equipment that change the status quo of the environment. Quite often, senior leaders within the military make non-programmed decisions to address new threats or opportunities. For this reason, many decisions on acquiring new military technologies are driven by the dynamics of the environment.

### 1. Rational Decision Making

The Rational Decision Making Model is used to help decision makers focus on facts and concrete information. The model provides considerable structure to the decision making process and helps decision makers avoid inappropriate assumptions and flawed logic. The aim of this approach is for the decision maker to obtain complete and perfect information before making a decision. Prescriptive in nature, the process involved in making the decision is focused on collecting sufficient information for the purpose of eliminating uncertainty [Ref. 5: p. 5]. After all of the information is collected, the decision maker evaluates all of the information rationally and logically.

The intended result of the rational approach to decision making is to produce a decision that addresses the goals of the decision makers or the organization. Although there are numerous variations, the most accepted process for this model found in the existing literature provides six steps [Ref. 6: p. 5]. The six steps commonly found in the rational decision making model are:

**1.) Recognizing the need for a decision**: Decision making occurs when it is necessary for an organization to address a gap between the actual state of the organization and the desired state.

**2.) Diagnosing the problem**: Diagnosis allows managers to understand why a gap between actual and desired states exists. Managers usually collect data and information about each plausible explanation for the gap.

**3.) Developing alternatives**: Only after identifying the cause of an issue can an organization begin to develop alternative solutions. According to classical decision making theory, all possible alternative solutions should be explored. This step includes establishing criteria for assessing alternatives.

**4.) Selecting alternatives**: Managers must decide which alternatives to implement. Optimal solutions are alternatives that address a particular issue in the most complete way possible at the lowest cost.

**5.) Implementing alternatives**: Implementation occurs when the ideas and principles represented in a decision are actually put into operation by organizational members.

**6.) Exercising control and follow up**: The rational decision making process is completed only when members of the organization exercise control and follow up.

There are two main issues related to the structure of the Rational Decision Making Model that create problems for decision makers. Specifically, these issues center on various assumptions that are made about the information collection and decision process. First, the rational model is prescriptive in nature. It describes what ought to be rather than

the current reality. The model also assumes that the decision maker is able to obtain complete and perfect information before making a decision. Within the literature, there is sufficient acknowledgment of this issue, so that decision theory provides approaches for making decisions under certainty, risk and uncertainty. Unfortunately, analysis of the information and the subsequent assessment of the value of that information remains subjective.

The second issue involving the Rational Decision Making Model focuses on the decision maker's ability to determine the best decision. The Rational Decision Making Model provides several structured and quantifiable methods of analyzing the information about potential alternatives. However, this analysis does not necessarily guarantee the optimal alternative will be selected. As previously discussed, the decision is based on the information collected about each alternative. Under conditions of certainty, the decision maker is aware of the alternatives and is aware of the outcome of each alternative selected. However, if the collected information is not pertinent to the decision, the use of perfect information is of little value in the final decision. Furthermore, senior managers are rarely presented with decisions involving perfect information. In most cases, decisions made under certainty are limited to recurring problems that have the historical basis discussed earlier in this chapter. Most decisions faced by senior managers involve risk or uncertainty. Figure 2-1 provides a graphical depiction of the types of conditions faced by decision makers and the amount of ambiguity and subsequent chances of making a bad decision based on that ambiguity.

Decisions made with risk assumes that the decision maker has knowledge of the probability of the outcome of an alternative. However, the decision maker does not know

the outcome that will occur in each alternative [Ref. 7: p. 358]. Decisions made under uncertainty introduce additional problems with the validity or value of the final decision. In this situation, the decision makers are aware of the possible outcomes of decisions but have little idea of the probability of the outcome occurring.

**DECISION MAKING CONDITIONS**

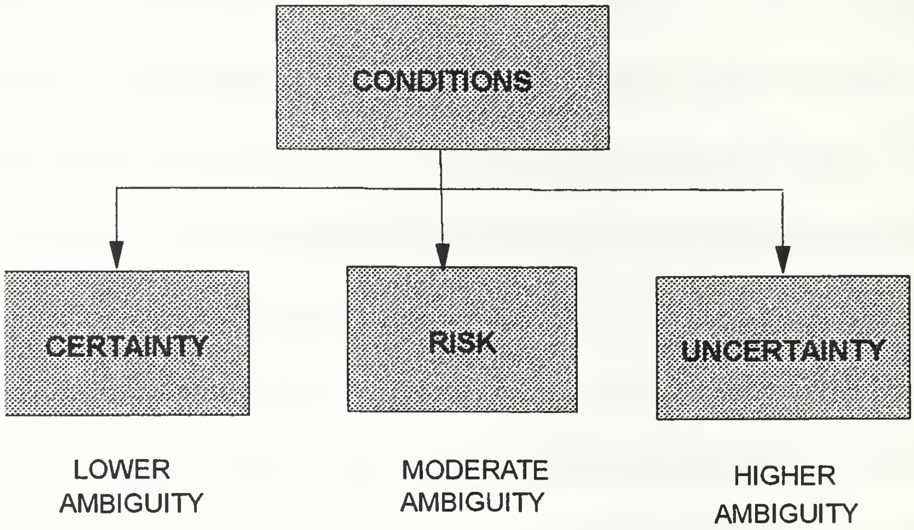


**Figure 2-1**. Decision Making Under Conditions of Uncertainty

### 2. Behavioral Decision Making

The rational approach to decision making is a very logical and structured approach. Often the decision maker is limited in his or her ability to either collect, process or analyze the information related to the issue. In some cases, it is extremely difficult to quantify the information sufficiently to effectively use the rational decision making process. Perhaps as importantly, decision making in organizations is affected by a variety

of social and psychological inputs. These inputs are difficult, and in many cases impossible, to factor into the rational decision making process.

The Behavioral Decision Making Model begins with a critique of the Rational Model. It provides a framework for how decisions are made based on the premise that senior managers often make decisions based on incomplete information and that they are constrained by bounded rationality [Ref. 5: p. 7]. Bounded rationality is a term used to describe the limited capacity of decision makers to collect and analyze information relevant to the decision. In fact, current literature on decision making views most decisions to be under conditions of bounded rationality. Rationality is bounded because the decision process is constrained. There are limits on the number of alternatives known and considered, and there are limits on the amount and accuracy of the information utilized in the decision process [Ref. 5: p. 8].

Attempts to achieve a goal stimulate a search for alternatives which continues until selection of an alternative that is good enough to satisfy the existing goal. The search process concentrates on areas of old alternatives, and through trial and error, selects a solution that makes marginal improvements to the present situation. Figure 2-2 illustrates how decision makers are affected by environmental influences and constraints. Difficult or more complex decisions typically involve more demands on limited resources. As a result, decision makers tend to search for satisfactory solutions as opposed to the single best or optimal solution. However, because decision makers gravitate to alternatives that satisfy immediate issues, the process becomes iterative. Problems not addressed by the less than optimal solution must often be revisited in subsequent decision making activities.

# BOUNDED RATIONALITY MODEL

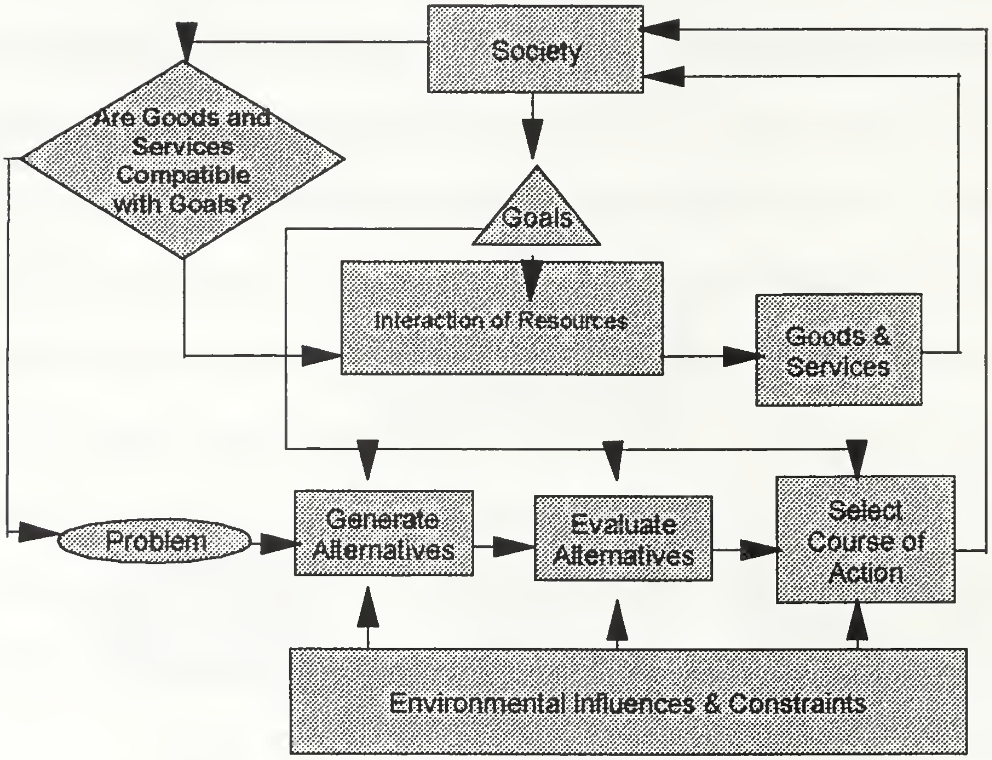


**Figure 2-2.** Bounded Rationality Model [Ref. 6: p. 9]

## C. CONCLUSION

Research reveals that there are two basic approaches to decision making: programmed and nonprogrammed decision making. Both decision making approaches address steps that include identification, possible solutions and various influences on the decision. Complex and difficult problems require decision makers to make non-programmed decisions with less than perfect information. Both approaches also offer the decision maker a structured approach to arriving at decisions. The following chapters

introduce an actual technology acquisition case and analysis of the effects of decisions using existing models.

## III. TECHNOLOGY ACQUISITION : A CASE STUDY

### A. INTRODUCTION

The following represents a brief synopsis of the acquisition of a management information system (MIS) for the North Atlantic Treaty Organization's (NATO) Supreme Headquarters Allied Powers Europe (SHAPE). The synopsis, based on my experience as a senior software analyst assigned to SHAPE during the early nineteen-nineties, serves to illustrate one decision making process involving technology acquisition [Ref. 8].

The case is presented by providing background on the environment and by providing specific information related to the technology acquisition. The issues that surface in the implementation of the SHAPE management information system are important from the perspective of future technology acquisitions. As you read the case, you will discover that certain factors or the combination of those factors contributed to reduced productivity, increased costs and an overall negative appraisal by many users of the new MIS. Consider which decisions contributed to the issues raised in the SHAPE MIS case. Also, consider how the decision making model employed by senior managers affected the successful implementation of the technology.

### B. BACKGROUND

SHAPE represents the coordinating headquarters for all NATO military and peacekeeping operations. The Modified Harvard Model provided at Figure 3-1 is introduced as a structured methodology to describe SHAPE, its mission and the various components of the organization [Ref. 9: pp. 1-8 ]. The model also serves as a strategic management tool that illustrates the interrelationship between the environment, key success factors, strategies, organizational design factors and cultures.

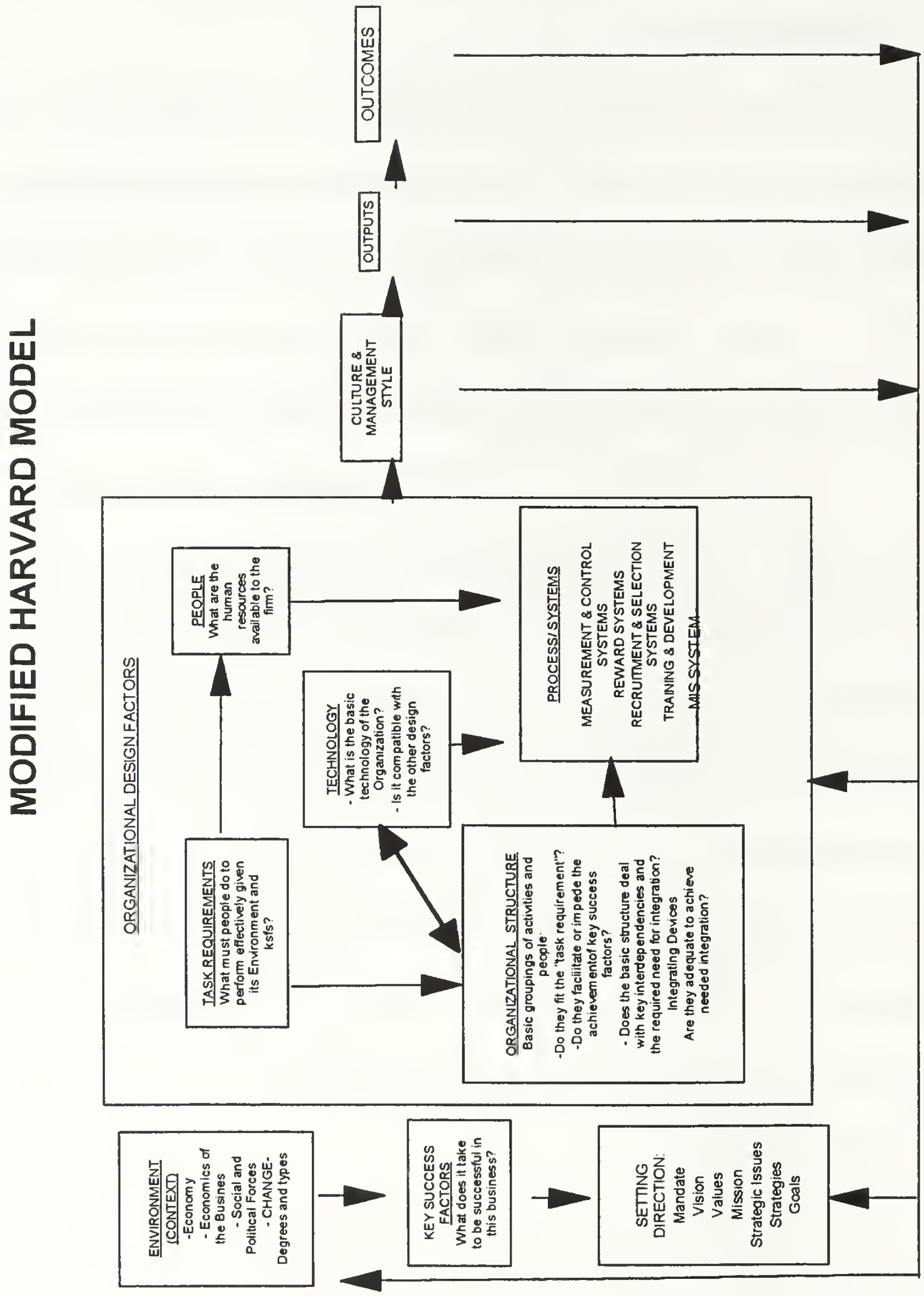


**Figure 3-1.** Modified Harvard Model [Ref. 9]

In this case, each of these areas are discussed but emphasis is placed on the organizational design factors delineated in the Modified Harvard Model.

The environmental context of SHAPE centers on the intensely political nature of the organization. In existence since the conclusion of World War II, SHAPE has served as the military headquarters for the sixteen member, North Atlantic Treaty Organization for over fifty years. During that period, the complications associated with the interaction of various nationalities and their differing languages, cultures and national goals have raised issues in the past including France's departure from NATO. However, the overarching goal of providing a unified military force for the defense of Europe has served to mitigate many of the problems inherent in different languages and cultures.

The political nature of SHAPE can be illustrated by the process used to assign officers to SHAPE. Assignments within SHAPE are based on positions by nationality and rank that are brokered and realigned each year. The Americans have a certain number of senior officers in specific positions. The Germans have a specific number of senior officers in various defined positions, as do the British and all of the other members of NATO. The determination of assignments and numbers of overall positions and senior leadership positions are based on the respective country's contribution in manpower, equipment or funds to the NATO infrastructure. Quite simply, the more resources that a country contributes, the greater number of influential positions and the greater number of overall positions it holds.

The key success factors for SHAPE are based on the headquarters' ability to command and control the NATO military force structure during peacetime and war. Inherent in the description of success is the successful application of pertinent staff

activities involved in planning for and sustaining the force structure. Although success is clearly determined by the organization's ability to plan, execute and sustain military and peacekeeping operations, a secondary measurement of success is tied to the political context in which SHAPE operates. Because of the environment, success is also determined by the ability to plan and effectively operate given often parochial constraints established by a council of civilian ministers appointed from each country.

Direction setting and vision for the organization is established by the Supreme Allied Commander Europe (SACEUR). The SACEUR is a four star general officer position held by a United States military officer since SHAPE's inception. The SACEUR provides strategies and goals for the organization's senior leaders and personnel. During the period of this technology acquisition, one of the SACEUR's goals directly applicable to this case study focused on sustaining the viability of the headquarters in view of planned reductions in personnel, funding and other resources.

Organizational Design Factors represent a subset of the Modified Harvard Model that serves to describe the tasks, people, structure, process and technology of the organization. This information is provided as a subset of the Modified Harvard Model because it represents the areas that a senior leader or decision maker can exert some level of control. This subset, described in Figure 3-2, represents the critical information required to examine the SHAPE MIS acquisition. Details for each of the Organizational Design Factors are provided in the following paragraphs.

## ORGANIZATIONAL DESIGN FACTORS

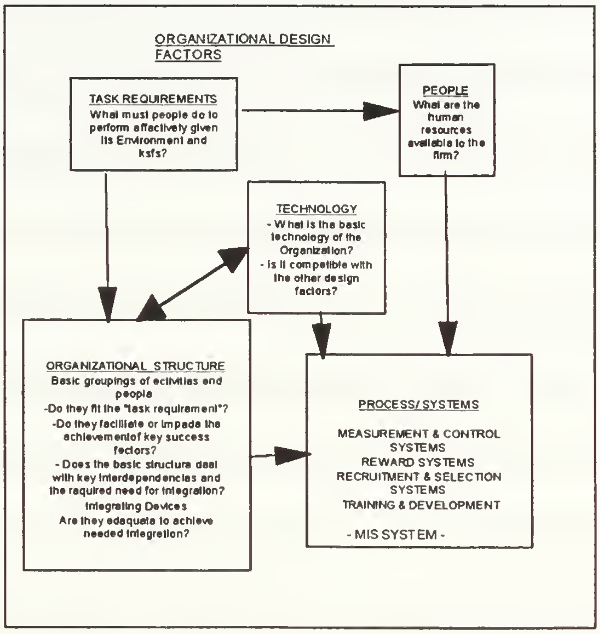


**Figure 3-2.** Organizational Design Factors After [Ref. 9]

The task requirements for staff officers and support personnel focused on coordinating the actions of several subordinate regional headquarters elements, countries that contribute resources to NATO and the civilian infrastructure represented by the NATO civilian leadership. The tasks included the creation of staff planning documents for resource requirements, wartime and peacetime operational planning documents and those efforts required to support a headquarters responsible for coordinating the activities of several Corps or Army sized elements. Staff actions and other documents were developed by staff officers and then produced by administrative personnel on stand-alone, low-end computers. Staff actions that required coordination between several elements within the

organization were transferred using paper copies or by exchanging floppy disks with the requisite information.

The people involved in performing the tasks associated with the activities at SHAPE included staff officers and support personnel. As previously discussed, staff officers were assigned to SHAPE from any of the NATO member countries. Generally, positions were filled by military personnel, but some positions were manned by civilians. Positions ranged from general officers to noncommissioned officers and included all services. Civilian positions ranged from senior positions with grades equivalent to a general officer down to lower level maintenance and administrative positions.

Military staff officers and many of the senior civilian support personnel held undergraduate degrees in a number of different specialties. Specific education requirements for staff officers were limited to a recognized or accredited undergraduate degree. Support personnel such as budget personnel, computer technicians and legal counsels required specialized degrees. Administrative personnel were not required to hold undergraduate or advanced degrees in administration.

Each individual assigned to SHAPE was also required to have a working knowledge of English or French. This command of the language included verbal and written fluency. Administrative personnel were also required to meet the same language proficiency requirements but were held to a stricter standard during their evaluations. They were held to a stricter standard because most administrative personnel, particularly secretaries assigned to division and branch positions, were responsible for ensuring that documents produced within the headquarters were administratively, as well as linguistically, correct.

The organizational structure of SHAPE was hierarchical and functional. The SACEUR coordinated activities with the NATO civilian leadership and provided strategic guidance to the senior SHAPE staff. The Deputy SACEUR was responsible for translating that guidance to the Chief of Staff who was responsible for the daily coordination of staff activities with each of the Division Chiefs.

Functions were aligned by divisions which included operations, logistics, policy and requirements, communications and intelligence. Additional staff functions included activities such as finance, legal, personnel and automation support. Staff officers were assigned to each of the various divisions by function. Intelligence officers were assigned to Intelligence Division, Operations officers were assigned to the Operations Division and the same type of structure occurred throughout the headquarters. Within each of the divisions, officers were assigned to static branches established to address specific divisional staff functions. Coordination between divisions was facilitated by staff meetings between senior staff officers. Specific actions were accomplished by junior staff officers within affected branches. This organizational structure had been in place for several years, and there were no published plans to significantly change either the hierarchy or the functions of any division.

The processes and systems used throughout the headquarters focused on standard operating procedures. Every staff officer assigned to SHAPE attends a five day or ten day orientation course that details the organization and the procedures used to address standard staff actions. Additionally, all of the established procedures were well documented and provided to each officer as a guide for future staff activities.

Many processes were division specific. Because assignments were based on functions, staff officers rarely transferred between divisions during their two or three year assignments to SHAPE. However, there was commonality in terms of procedures within the various branches within a division. Therefore, it was not uncommon for an individual to move from branch to branch within the same division. Often, a move within a branch was preceded by additional training related to the new position.

SHAPE offered several courses, schools and training facilities that were available to staff officers based on specific training requirements. Language training, computer courses and various courses related to functional areas were made available on a regular basis. Because the facilities for these training courses were located throughout Europe, course attendance was often provided as a reward.

The technology of the organization was limited to lower level office automation technology and coordinated information processing. Military staff officers brought specific functional skills to the organization. In line with the structure of the organization, staff officers brought specific knowledge and experience related to intelligence, logistics or operations. Support personnel brought specific technical and administrative skills. Generally, verbal communication and paper documents were exchanged between staff elements within SHAPE and with external subordinate units. Limited information was forwarded using automated systems with the exception of a few classified intelligence and logistics systems. Daily staff activities were conducted using older non-networked computers and typewriters.

## C. TECHNOLOGY ACQUISITION

For several years, individuals within each of the functional and support staff elements had complained about outdated and non-networked office automation. As a result, a written requirement was approved and funds were allocated for a MIS. A users group with representatives from each of the primary staff elements was created to assist the computer engineers in designing the MIS. A general officer, responsible for the Personnel Support Division, was assigned decision making authority for the user group.

After six months of conducting a requirements review, the users group provided a list of hardware and software requirements to the engineers responsible for selection of the MIS. The engineers, through the SHAPE contracting officer, purchased both the number of systems and the capabilities desired by the users. The new MIS focused on leading edge technology and automated staff operations in a networked environment.

Soon after the MIS was installed, several performance shortfalls became evident. The first issue involved the software installed on the system. The users group had requested word-processing, database and spreadsheet software. The contractor provided an integrated software product that provided each of the capabilities requested. However, administrative personnel and staff officers were reluctant to use the integrated software package because it failed to provide both the capabilities and ease of use that their existing software provided. Additional training planned and implemented by the engineers failed to completely remedy this issue. The MIS also operated in a secure environment. As a result, users were unable to install or uninstall software from their individual workstations. Users found this inconvenient because of the substantial amount and frequency of data that had to be transferred between different subordinate headquarters and NATO countries. Finally,

in order to finance the purchase of the MIS, administrative personnel such as secretaries and clerks were terminated and provided with separation packages.

The software issue presented both initial user acceptance problems and additional costs. Although representatives from each of the staff elements participated in the decision making process, actual users, staff officers and administrative personnel who would use the systems were not included. At this point in the acquisition, software developers assigned to SHAPE were brought in to help resolve the software problems. Prior to this point in the acquisition, software developers were not included in the decision making process. A survey of software applications on existing stand-alone platforms indicated that personnel within the headquarters used several popular trademarked commercial software applications. Specifically, personnel used Wordperfect for word-processing, Lotus 1-2-3 for spreadsheets, Harvard Graphics for graphics and Dbase III for all database applications. Unfortunately, hundreds of the installed applications were illegal copies and presented the headquarters with a difficult legal situation. Although the organization was transitioning to a new MIS, an additional $100,000 was spent to purchase site licenses and documentation for the software in use. Additional copies of the legal software were also purchased to install on the new MIS.

Transfer of the data files from the old stand-alone systems to the MIS was time consuming and expensive. To avoid an unacceptable cessation or delay in critical staff activities, both the old platforms and new MIS were operated simultaneously. Computer operators and maintenance personnel who needed training on the new MIS were required to service existing systems instead of focusing on learning the new MIS. Additionally, because the same software and data were maintained on the old platforms as well as the

new MIS, the planned transfer of the old stand-alone systems to new users was delayed by over three months.

Perhaps the most noticeable byproduct of the acquisition was the accelerated reduction of administrative personnel. Undoubtedly, the down-sizing of personnel on the SHAPE staff was an inevitable result of the demise of the Soviet Union and Warsaw Pact. However, the implementation of the MIS was viewed as a justification to accelerate the elimination of several administrative positions. Unfortunately, the loss of administrative personnel affected the productivity of the staff officers assigned to SHAPE.

An example of this loss in productivity was found in the requirement for staff officers at SHAPE to produce numerous documents and reports in English. As an international and joint service headquarters, the language requirements for all official correspondence within NATO is French or English. All military staff actions were done in English. Because of this requirement, the majority of administrative personnel were from Great Britain or Belgium and each demonstrated complete fluency in French and English.

Although NATO staff officers are required to have a working command of English or French, producing lengthy and often complex documents on a new computer system proved to be challenging for many staff officers whose primary language was not English. Even though the officers were competent in their functional areas, there were difficulties in two areas. First, the staff officers had limited experience using the new hardware and software. Second, there was also some difficulty associated with having to produce documents in a proper format and grammatically correct English.

There were other consequences of the loss of administrative personnel. In addition to typing reports and correspondence, staff officers were then required to answer

telephones, schedule conferences, arrange travel and perform other tasks previously handled by administrative personnel.

## D. DECISION MAKING PROCESS

The planners and decision makers in the SHAPE management information system acquisition employed a commonly used methodology employed by technologists in many organizations. The Systems Development Life Cycle (SDLC) is a structured process used by decision makers to acquire hardware and software technologies. Like the Rational Decision Making Model, the SDLC consists of six phases. The six phases as discussed by James A. Senn, author of Information Technology in Business: Principles, Practices and Opportunities, are listed and presented below. [Ref. 10: pp. 431-451]

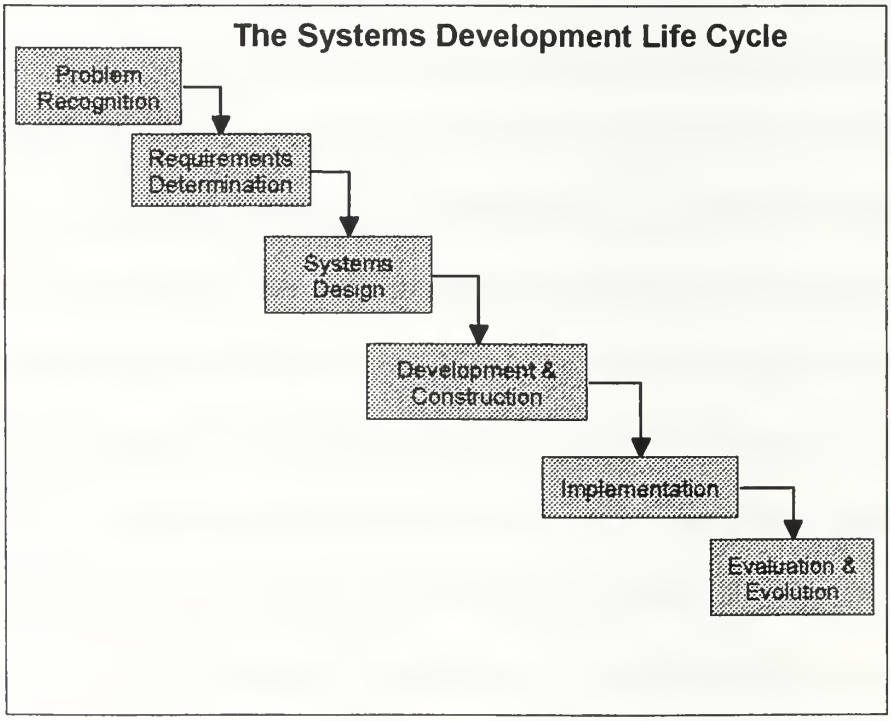


**Figure 3-3.** Systems Development Life Cycle Model [Ref. 10: pp. 431-451]

## SYSTEMS DEVELOPMENT LIFE CYCLE

**1.) Problem recognition/preliminary investigation** - Defining and investigating the problem.

**2.) Requirements determination** - Understanding the current system and the new system's requirements.

**3.) Systems design** - Planning the new system.

**4.) Development and construction** - Creating the new system.

**5.) Implementation** - Converting to the new system.

**6.) Evaluation and continuing evolution** - Monitoring and adding value to the new system.

Each of the six phases are explained in more detail, using descriptions provided by Senn and using the SHAPE management information system as a reference. The first phase, Problem Recognition and Preliminary Investigation, focuses on determining the real problem. Most organizations have limited resources and several demands on those resources. As a result a standing or ad hoc committee is normally charged with examining proposals or requests for new technology. In the case of SHAPE's management information system, an ad hoc users group was established.

> **Problem Recognition/Preliminary Investigation**
> The purpose of the preliminary investigation is to examine the project proposal (1) to evaluate its merits and (2) to determine whether it is feasible to launch a project that will address the issues it raises. During the preliminary investigation, systems analysts work to clarify the proposal, determine the size and scope of the project, assess the costs and benefits of alternative approaches, and determine the project's general feasibility. They then report their findings to the steering committee along

with a recommendation. Systems analysts assess three types of feasibility: operational feasibility, financial/economic feasibility, and technical feasibility. [Ref. 10: p. 431]

SHAPE required a method of sustaining productivity after the anticipated reduction in administrative personnel. Although a mainframe computer existed at the headquarters, its use was dedicated to logistics applications. Office automation in the form of networked inexpensive desktop computers was viewed as the solution. Additionally, because of the enhancements and proliferation of word-processing, graphics and database software, there was an expectation that office automation would increase the productivity of the SHAPE staff. Software analysts, as well as members of the SHAPE staff, investigated whether a MIS could be implemented to reduce the effects of projected staff reductions and increase the staff's productivity. The investigation focused on the available technology and the cost of the technology. Project officers interviewed numerous office automation vendors that presented proposals that illustrated their systems, technical capabilities and costs. The project officer's analysis focused on processor speed, network load, server capacity and upgrade capabilities. The result of this quantitative analysis was a belief that a networked office automation system would increase productivity at an acceptable cost in resources to the organization.

**Requirements Determination**
A requirement is a feature that must be included in a system. It may be a way of capturing or processing information, a method of interacting with the system, a processing activity or result, a piece of information displayed or printed as a result of processing or a function that can be performed to safeguard data and information. [Ref. 10: p. 435]

There were numerous requirements associated with the SHAPE management information system. As with most information systems, database management was a key requirement. The MIS project team followed accepted documentation standards to record user requirements [Ref. 11]. Additionally, because of the large size of the staff, e-mail and scheduling software were identified as key requirements. However, another requirement previously mentioned called for a multilevel secure network system in a client-server environment. At the time, there were no systems in NATO that met this requirement. As a result, this requirement created additional risk to both the implementation and user acceptance of the system. The additional risk was based on the state-of-the-art software employed to meet the multilevel security requirement. Commercially, there was limited experience in implementing multilevel secure software. Additionally, because of the immaturity of the security software, it could potentially fail to interact with other software applications. Four years after its implementation, the SHAPE management information system has yet to meet this requirement [Ref. 12].

> **Systems Design**
> Systems design takes place in three phases: preliminary (conceptual) design, prototyping, and detailed (physical) design. The preliminary design of a system specifies its distinguishing characteristics, conceptualizing the functions it will perform and how they will occur. Current systems capabilities will influence the design. The detailed, or physical, design of a system specifies its features. The accompanying documentation consists of definitions explaining the characteristics of the system, its processing activities, and the reports and charts it can generate. [Ref. 10: p. 443]

The project management team conducted all three phases of the system design process. The team consisted of two computer hardware engineers who developed the preliminary system design. The second and third phases were conducted in conjunction

with the hardware and software contractor responsible for developing the system. A prototype system was viewed by only the SHAPE MIS project team and the contracting officer at the contractor's facility. The first time actual users saw the system was during the implementation phase.

> **Development and Construction**
> During development and system construction, the system is actually built. Physical design specifications are turned into a functioning system. The principle activities of development are the acquisition of software and services, computer programming, and testing. [Ref. 10: p. 447]

The contractor responsible for integrating both the hardware and software components of the basic management information system attempted to meet all of SHAPE's requirements. Both the hardware and software components of the system were purchased from reputable commercial vendors. Quality engineers from within the SHAPE staff performed very comprehensive acceptance testing. During installation, issues were resolved by an on-site team of contractor representatives. Additionally, a software engineer remained at SHAPE for one year to address any issues related to the system.

> **Implementation**
> During implementation, the new system is installed and put into use. New systems often bring many changes to a business, including new business procedures, different individual responsibilities, and adjustments in the flow of information. Three important aspects of implementation are training, site preparation, and conversion strategy.
>
> Training. Even experienced computer users need to become familiar with the features of a new system. During training, IT professionals show people how to use the system and how to keep the system running and reliable. Training covers all aspects of using the system, from routing procedures to periodic actions (for example, replacing printer cartridges) to emergency operations (for example, the steps to take in the event system security is breached). We tend to think of "training" as the training of end-users who are part of a work group. But IT professionals also need training themselves when a new application is installed. IT

professionals must often know both the user's procedures and the administrator's procedures to keep the network, server, or other components up and running.

Site Preparation. Sometimes new systems mean new equipment and furniture and the construction of additional facilities (for example, new electrical wiring, air conditioning systems, lighting systems, and security systems). These activities involved in preparing for the installing of a new system are called site preparation. Site preparation can be minimal or extensive. If a new system requires the replacement of existing microcomputers with more powerful models, changes in the work site may not be needed. The old computers are simply unplugged and carried away and the new ones are installed in their place. If a local area network will be installed in an office for the first time, however, site preparation may entail running communications cables, building a cable connection room, and installing cable plugs in the wall.

Conversion Strategies. A conversion plan describes all the activities that must occur to change over to a new system. It identifies the persons responsible for each activity and includes a timetable for the completion of each event. These activities include assigning responsibility for ensuring each activity is completed, assigning and verifying dates on the conversion schedule, listing all databases and files to be converted, identifying all the data and information required to build databases and files for the system, listing all new procedures that go into use during conversion, and outlining all the controls that will be used to ensure that each activity occurs properly. [Ref. 10: p. 449]

The project manager for the SHAPE management information system intended a dual implementation policy. The entire headquarters building was laid with fiber optic cable. However, a pilot program that equipped only two divisions within the headquarters was instituted. The project management team's conversion plan directed that existing stand-alone computers be swapped for new systems and then provided to offices without existing office automation. This plan was the direct result of an incremental procurement strategy. Funding constraints dictated that a limited number of new systems were purchased in the initial contract. A training facility was created and the automation personnel conducted four hours of training for personnel throughout the headquarters. Training focused on providing basic instruction on the characteristics of the new hardware

and specific application usage. Training was provided to administrative personnel and staff officers throughout the headquarters. However, personnel in the divisions scheduled to receive the initial set of computers were front-loaded into the training sessions.

Delays in training a sufficient number of automation personnel and the large volume of data required for transfer caused a delay in the transition of the old stand-alone systems. A limited number of automation personnel from within the headquarters received an early issue of computers. Another aspect of the implementation plan was the actual distribution of the systems. In many cases, because of the requirement for the use of e-mail and scheduling applications, systems were placed in the offices of senior staff officers. As a result, staff officers with the greatest need for the data management, word-processing and graphics applications had limited access to the new systems.

> **Evaluation and Continuing Evolution**
> Once implemented, analysts perform systems evaluation to identify the strengths and weaknesses of the system. They want to determine if the system delivers the expected level of usability and usefulness and if it is providing the anticipated benefits. Systems are often used for many years. However, the organization, the people using the system, and the business environment will change. For this reason, all systems need to undergo continuing development, with features being added and capabilities augmented as new or improved technologies are introduced. [Ref. 10: p. 451]

Several meetings were conducted with users to address issues related to the system. The results of those meetings were reflected in the upgrading and replacing of software applications and the redistribution of platforms throughout the headquarters. Additional memory was added to the system and a faster processor was installed on each platform because of numerous complaints about the speed of the system. The project manager worked extremely hard to try and satisfy issues surfaced by the user. The

contractor responsible for the system worked equally hard to address issues raised by the project manager.

## E. CONCLUSION

Chapter III provides an overview of SHAPE and some of the specifics of the acquisition of a management information system. The overall goal of the acquisition was to provide staff officers a set of more efficient tools in the form of office automation hardware and software. Project managers employed the Systems Development Life Cycle Model to facilitate decisions related to requirements, design, development, implementation and evaluation. The following chapter analyses the model effectiveness in the technology acquisition decision making process.

# IV. CASE ANALYSIS

## A. INTRODUCTION

A cursory analysis of the SHAPE MIS would lead one to believe that many of the issues raised in the case were the direct result of problems during implementation. A more in-depth analysis indicates that many problems in this case, and in potentially many other technology acquisitions, may result from shortfalls in the decision making model used by senior leaders and decision makers.

The following sections discuss two important aspects of the SHAPE MIS acquisition. First, the decision making approach and model used in the technology acquisition at SHAPE is examined. Then, several of the issues raised in the SHAPE case are examined in relation to the model and their affect on the initial and long-term effectiveness of the MIS.

## B. DECISION MAKING MODEL

The decision makers at SHAPE employed the Systems Development Life Cycle Model (SDLC) to assist in decisions related to the SHAPE MIS. The SDLC is a widely accepted tool for assisting decision makers in technology acquisitions and specific technology development efforts. Based on the review of two common decision making models provided in Chapter II, the SDLC is consistent with the rational approach to decision making.

Like the Rational Model, the SDLC uses a defined methodology in an attempt to provide the senior leader with precise information from which to make decisions at various stages of the acquisition process. The goal of this structured approach is to reduce the risk of making a bad decision based on the lack of information. Each step in the SDLC closely

parallels the six steps in the Rational Decision Making Model. Unfortunately, that parallel includes some of the same potential shortfalls found in the rational approach to decision making.

As introduced in Chapter II, the rational approach to decision making relies on obtaining perfect information. At SHAPE, perfect information was not available to the decision makers. An example of imperfect information is illustrated by the conversion technique employed at SHAPE. Each user's requirement for their existing systems, as well as the amount of time required to transfer existing data to the new system, were difficult for the decision maker to control or predict. However, decisions made early in the process were based on some quantifiable time and data transfer requirements.

The rational approach to decision making also assumes that the decision maker is able to recognize and select the best alternative. Although the case does not focus on the different technologies and alternatives that were available, the case does highlight the conversion technique employed by the project team. The decision makers selected direct cut over as the conversion technique. Direct cut over is the process of replacing existing systems with new systems without a transition period. There are strengths and weaknesses to this approach. One strength is that it forces the users to employ the new technology immediately. Also, the older systems can be assigned to other personnel or sold at some agreed upon depreciated value. Potential weaknesses focus on schedule changes or problems with the functionality of the new system.

Decision makers at SHAPE assumed that the new system would immediately meet the users' requirements. Unfortunately, training and data transfer issues caused schedule delays. Users refused to release their old systems until the new systems were proven

reliable, their data was transferred and they received appropriate training. As a result, many users were disenchanted with the system because it caused them extra work. Because of the need to maintain data on both the old and new systems, productivity decreased from the minute users received the new system. Additionally, individuals who were programmed to receive old systems were disappointed because of the schedule change and resulting delays. As a result, there was a negative perception of the reliability and capability of the new system by both users and non-users.

The rational approach to decision making also attempts to provide a common basis for decision makers to evaluate alternatives. The SDLC follows this methodology by providing steps that require decision makers to choose between alternatives at specific steps. The only means available to the decision maker to facilitate this choice of alternatives is to develop a surrogate means or common basis to compare one alternative to another. In most cases, this common basis is represented quantitatively. At SHAPE, the cost of various technology alternatives were compared using processor speed, network load, memory and storage capacity as a basis for evaluation. However, this quantitative assessment did not take into consideration many non-quantitative factors that will be introduced in Chapter V of this research. This omission in the rational approach to decision making contributed to several key issues that occurred in the SHAPE MIS case.

## C. KEY SHAPE MIS ISSUES

The SHAPE MIS case presents several issues that result from decisions related to technology acquisition. Many of these issues are the result of specific interpretation or poor implementation of the SDLC. Other issues are directly related to what I believe to be a deficiency in the SDLC and the rational approach to decision making. Analysis of the

issues will indicate that the SDLC fails to provide decision makers with an encompassing or more complete view of the technology and its interaction with the components of the organization. Although the case presents several issues, for the purpose of this thesis, only the following key issues will be discussed.

- Requirements and Measurements of Success
- Personnel/Administrative Reductions
- Culture and Environment
- Training

## D. ANALYSIS OF KEY ISSUES

### 1. Requirements and Measurements of Success

The requirements and measures of effectiveness for the acquired MIS were ill-defined. Members of the project team were comfortable viewing the acquisition in terms of finding the most capable software or hardware technical solution. Their success was based on their ability to provide an automation solution to the SHAPE staff. The solution was not tied to a certain quality or effectiveness level. General requirements were established at the outset but were not revisited by the decision makers. The contracting officers assigned to the project team were interested in developing the optimum contract vehicle to obtain the desired MIS. However, there was little discussion in the case about interaction with the users to determine the best technology alternative.

A more in-depth analysis of users' requirements may have served to mitigate some of the software deficiencies. The SDLC provides a step for identifying the requirements for the new system. However, the SDLC does not specifically address how to measure whether the stated requirements are accurate and achievable. If users at SHAPE required a

database system to track logistics, not only should the requirement for the system have been defined but also the users' perception of a successful system should also have been defined. The definition of success may have been difficult for systems analysts to determine. However, prior to making decisions on a specific technology acquisition, decision makers should have evaluated an analysis of success from users' perspectives.

### 2. Culture and Environment

The decision makers at SHAPE failed to consider the culture and the environment of the organization. Many military officers were not prepared to assume new responsibilities previously provided by predominantly female administrative personnel. The reduction in administrative personnel and the introduction of e-mail into the headquarters created the need for all staff officers to spend more time using a computer. Although most American officers easily made the transition to the MIS, many European officers had difficulties adjusting to the changes introduced by the new system. Although there were training implications with the increased requirement for staff officers to use computers, there were also cultural implications.

Again, the SDLC fails to provide a means for providing decision makers with insight into non-quantifiable variables. Cultural and environmental issues are not addressed in any of the model's six steps. Officers selected to serve at SHAPE represented the best of their respective services. As an example, American officers are required to go through a formal nomination and selection process for assignment to SHAPE. Other countries follow a similar assignment process. As a result, the officers at SHAPE may have had the perception of being elite or special. The new system required officers to perform skills that were previously reserved for administrative or support personnel. If the staff officers

perceived these tasks to be beneath their standing, they may not have been receptive to using the new MIS. Understanding the culture and environment may have helped decision makers at SHAPE to better prepare users for the new system.

### 3. Personnel/Administrative Reductions

The acquisition of the SHAPE MIS was directly tied to the desire to achieve increased productivity and prepare for anticipated staff reductions. However, the two issues were not viewed as exclusive events. Many users, specifically administrative support personnel, believed that the SHAPE MIS was the cause of the reduction. Decision makers should have recognized and acknowledged these concerns. More importantly, senior leaders should have attempted to inform the staff of the real facts concerning reductions in personnel and the acquisition of a new MIS. Even if the two events were linked, the personnel within the organization should have been informed. The failure of the senior leadership and decision makers to address this issue contributed to the overall negative perceptions about the SHAPE MIS.

This issue again illustrates one of the important shortfalls found in the rational approach to decision making. There are no provisions for assessing perceptions within the prescriptive structure of the SDLC. The SDLC does not provide a way to assess organizational perceptions attributable to the new technology. Decision makers are presented with merely quantifiable data from which to make decisions. Unfortunately, the success of a technology can be tied to the users' perception of the value of the system. This perception can make a poor technology successful and a good technology fail. [Ref. 13: pp. 49-51] Administrative personnel were concerned about their positions. The

perception of the SHAPE MIS as the reason for the elimination of positions may have contributed to users' complaints about the system.

#### 4. Training

Training was also a significant issue in the SHAPE MIS acquisition. The project team failed to identify specific training requirements tailored for users of the new system. A standard program of instruction was established for every user of the new system. The program team focused on providing every staff officer a basic introduction to the new system. However, different users brought different skill levels to the standard training session. As a result, some users received more training than they required while others received an insufficient amount. Resource constraints were an obvious consideration in the decisions related to training. Unfortunately, many users developed negative feelings toward the new system because of their lack of training on the new system's hardware and software.

The SDLC provides significant guidance on the requirement to address training in the acquisition of new technologies. The implementation phase of the SDLC model provides for decisions related to training. However, within the SDLC, the focus is on ensuring that training occurs and not on structuring the training to fit various users' requirements. The SDLC does address establishing specific training for the technicians who will operate and maintain the new system. However, project officers at SHAPE established a single training program focused on training a large number of users. Clearly, this decision contributed to the limited success of the SHAPE MIS. A more thorough assessment of individual training requirements could have helped to mitigate several of the training issues that occurred at SHAPE.

## E. LESSONS LEARNED

The key issues discussed in the SHAPE case indicate that there is a need to expand the rational approach to decision making. Specifically, decisions involving the acquisition of technology should include factors other than those that can be clearly quantified. Existing processes, culture, measures of success and other factors should be considered to accurately provide decision makers with complete information about the affects of the new technology on the organization. The following chapter provides a new model that incorporates the strengths of the SDLC with other factors that may improve decision making related to technology acquisition.

# V. TECHNOLOGY ACQUISITION MODEL AND ANALYSIS

## A. INTRODUCTION

How can senior managers make more informed decisions about technology acquisitions? If the reader accepts the shortfalls of the Systems Development Life Cycle Model as applied to the SHAPE case, perhaps a new model that introduces other organizational factors can assist decision makers. The Technology Acquisition Decision Making Model (TADMM) provides a more encompassing methodology for decision making related to technology acquisition. Emphasis is placed on senior management because the TADMM focuses on an acquired technology's affect on an entire organization and not specific segments or individuals.

## B. TECHNOLOGY ACQUISITION DECISION MAKING MODEL

The Technology Acquisition Decision Making Model (TADMM) is an iterative six step process for strategic decision making related to technology acquisition. The model does not take the place of human judgment or provide a list of options for managers to apply to specific situations. The Technology Acquisition Decision Making Model is a critical thinking tool that assists the senior manager in asking the questions that support informed decision making. Application of this model may take days, weeks, or even months. The better the senior manager understands his or her organization's goals, objectives and operating environment, the more effective this model is in its application. In the pages that follow, I will describe each of the steps in the Technology Acquisition Decision Making Model (Figure 5-1).

Additionally, I will provide details on the processes within each of the steps that assist the senior manager with the decision making process.

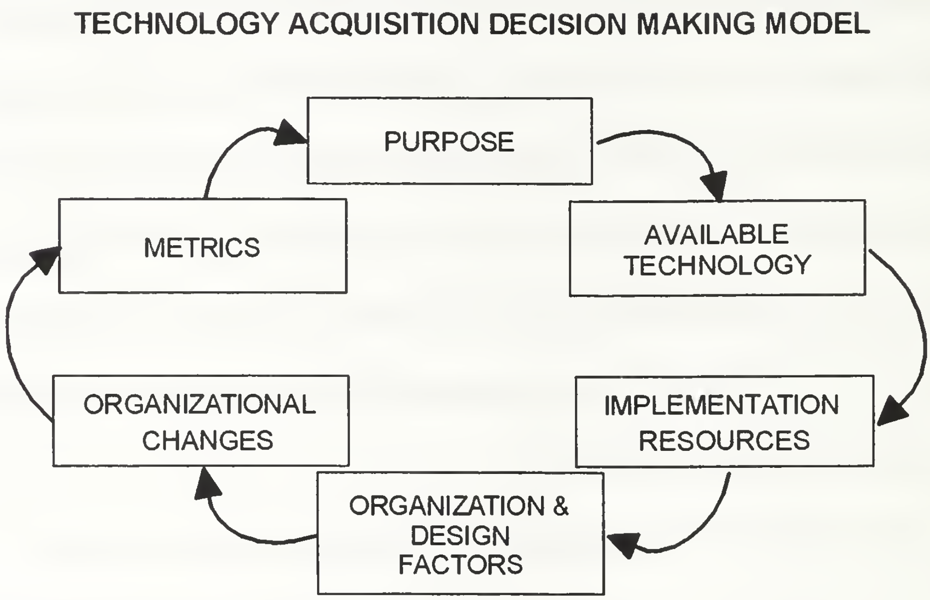


**Figure 5-1.** Technology Acquisition Decision Making Model

**Step 1. Purpose:**

What is the problem?
What segment of the organization does the technology affect?
How does the technology contribute to the goals of the organization?

**Step 2. Available Technology:**

What technological solutions are being proposed?
What are the costs and impacts associated with each of the alternatives?

**Step 3. Implementation Resources:**

What resources are required to implement each alternative?
Which resources are internal and which resources are external to the organization?

**Step 4. Organization and Design Factors:**

What is the current organizational structure of the organization?
What is the current organizational structure of the segment directly implementing the new technology?
What is the make-up of the workforce?
What are the tasks performed by the workforce?

**Step 5. Organizational Changes:**

Based on information collected in Step 4 and Step 5, what changes must occur to facilitate the new technology?

**Step 6. Metrics:**

How does the organization's management measure the benefits of the technology?
How does the organization's management measure the technology's affect on the organization?
How is information related to the technology collected and evaluated?

### 1. Purpose

In defining the first step in the TADMM, the decision maker must understand the purpose of the proposed technology. Other members of the organization, information officers, directors of departments, supervisors, and other technology advocates will have defined a problem or shortfall that they believe can be addressed by acquiring a specific technology. The decision maker must understand the purpose of the technology from two perspectives. First, where does this technology fit within the organization? Second, how does this technology contribute to the overall objectives of the organization? A short example is provided to illustrate these two areas of interest.

In the SHAPE case, the Chief of the Logistics Division desired a new system for tracking supplies, developing contingency plans and preparing staff reports for other NATO headquarters. He believed that the automated system would reduce errors and accelerate the staff process. The new technology, in the form of office automation

equipment, database, spreadsheet and word-processing software represented the technologies required by the Logistics Division to improve the staff process.

However, how does an automated system contribute to the overall objectives of the organization? Using the SHAPE MIS case as an example, the division chief may have proposed that the increased speed or reduction in errors achieved by the new system served as a method of improving the logistics posture of NATO. Or, the division chief may have viewed the new technology as a cost cutting vehicle for proposed personnel reductions. Another reason may have been that time savings could be applied to quality control issues within the department.

The senior manager must view the acquisition of a technology from both the perspective of the division as well as the entire organization. This perspective provides the decision maker with a more accurate assessment of the benefit of the acquisition. The decision maker's use of a systems oriented perspective ensures that the technology acquisition is aligned with the organization's goals. Decision makers must be confident that they understand both the tactical (lower level) and strategic (higher level) purpose of the technology acquisition. This understanding will help the organization's leadership to keep the organization's individual divisions and segments aligned with the organization's overall goals.

The strength of this step in the model is that defining the purpose of the technology early in the process eliminates the investment of resources in unproductive technologies. A new technology that does not contribute to the bottom line profit or quality of a product is a waste of precious resources. A technology that increases resource requirements without a commensurate return in investment is equally wasteful. The model

intends to move decision makers toward a more comprehensive understanding of the strategic and tactical purpose of the technology. By examining the technology from both perspectives, the decision maker limits potential unintended effects. By going through the process of defining the need and expected benefits of the technology, senior managers and employees throughout the organization can have a better understanding of how a technology contributes to, not only a specific segment of the organization, but also to the organization as a whole. Individuals who use the technology understand the impact of the technology on the organization and senior managers understand how the technology is used at lower levels of the organization.

The weakness of this step in the model is that it is easy for advocates of technology to camouflage the stated purpose of a given technology in nebulous verbiage. Words such as “increased efficiency” and “effectiveness” are difficult to quantify but serve as catchall phrases for the purpose of a new technology. In many cases, causal relationships are implied because of the success of similar technologies employed by other organizations. An advocate may state that, “Company X uses this particular technology and their profit margin is a certain amount.” Unfortunately, the technology is perhaps a small factor in the reason for company X’s success. However, often “me-too-ism” or a desire to remain with the competition without clearly exploring other organizational shortfalls result in adopting new technologies that have a limited impact on the goals and objectives of the organization.

The SHAPE MIS acquisition was specifically approached from the perspective of increasing efficiency and effectiveness at both the tactical (individual divisions and branches) and strategic levels. Broad statements defined the ability of the new system to

reduce maintenance costs, increase standardization in hardware and software as well as reduce personnel requirements.

At SHAPE, there were very specific lower level and upper level goals. The users group served as the vehicle for coordinating the alignment of purposes. Most decisions for hardware and software requirements were based on the specific needs of the primary staff elements (logistics, operations and intelligence). However, strategic organizational objectives such as connectivity by e-mail, event and meeting scheduling, staff coordination and overall staff effectiveness were enhanced by the implementation of the SHAPE MIS. Overall, the project management team and decision makers involved in the SHAPE MIS adequately addressed the first step of the TADMM.

### 2. Available Technology

Determining the available technology is an information collection process conducted by personnel who report to the decision maker. For the decision maker, the emphasis of this step is not in the collection of data related to technological alternatives. The purpose of this step is to quantify and qualify the contribution to objectives of the available alternatives.

A planning tool designed by the researcher is introduced to illustrate this concept. Figure 5-2 depicts a tool that provides a decision maker with a method of assessing relative risk in relation to various alternatives. Unlike other planning tools, this model attempts to correlate the cost of an alternative and the productivity impact into a decision resource and risk assessment for decision makers.

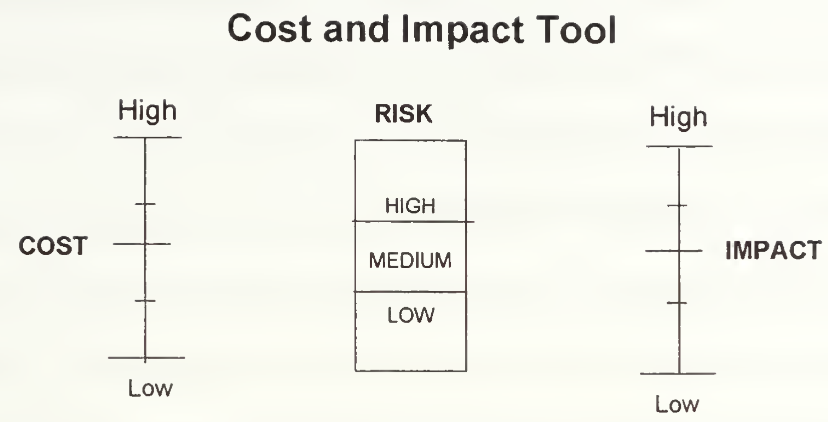


**Figure 5-2.** Cost and Impact Tool

The left column represents the cost associated with obtaining and implementing a technology. The cost for each technology is positioned on the scale. The range of the scale is based on the organization's determination of available funds. The right scale represents the impact or effect of the technology relative to the organization's internal and external environment. The low end of the scale represents proven technologies that marginally improve a process within the organization. The added value of the technology is measurable but does not position the organization in a dominant leadership role relative to the market or service provided.

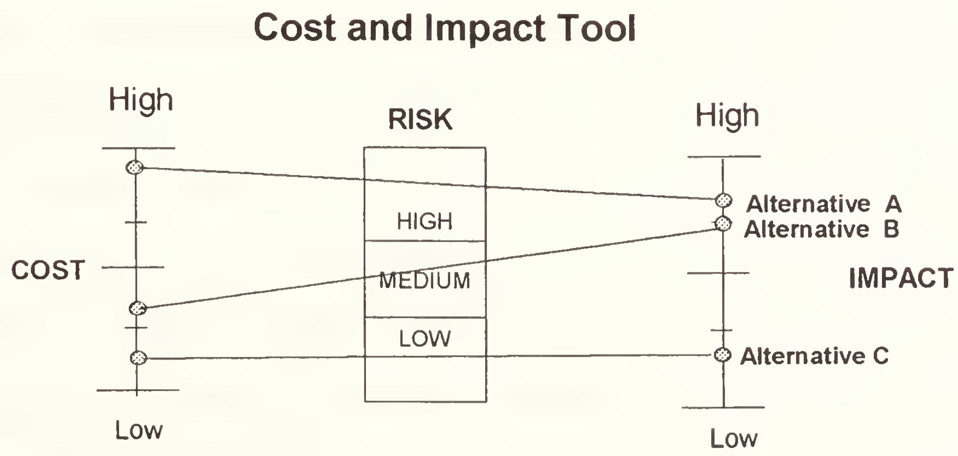


**Figure 5-3.** Sample Cost and Impact Tool

The high end of the scale represents innovative, state-of-the-art technologies that are untried and will significantly change internal processes and help to position the organization in a market leadership position.

Alternative C, in Figure 5-3 represents a low end technology acquisition. The decision is a low risk decision because it will result in marginal changes in some facet of the organization and can be achieved at a low cost in resources. The SHAPE case provides an example of the different types of technology acquisition. Decision makers at SHAPE could have opted for an alternative that replaced existing computers with faster stand-alone systems. The purchase of stand-alone computers with 486 processors would have been an improvement over the current 386 processor systems. However, there would have been a limited increase in the benefit of the acquisition.

Alternative A, represents a leap-ahead technology that can only be achieved with a substantial commitment of an organization's resources. Therefore, Alternative A represents a high risk decision. Again, the SHAPE case provides an illustration. The decision to procure a networked, multilevel secure system, even though no other NATO organization had successfully implemented a similar system, was a high risk decision. Existing procedures required separate computers to process certain categories or classifications of information. Therefore, additional systems were required for classified and unclassified information. The benefit of a multilevel system was that it allowed different classifications of material to be processed and stored on the same system. In addition to the cost savings based on eliminating duplicate systems, productivity was expected to increase because of time savings associated with all of the information stored on a single system.

The value of this new tool is demonstrated by a short analysis of Alternative B. The impact of Alternative B is substantial when compared to Alternative C. However, the cost in resources is substantially lower then Alternative A. The marginal benefit of Alternative A over Alternative B can be offset by the difference in cost between the two alternatives. This tool can help the decision maker to view the technology acquisition decision from a more systems oriented perspective. Cost data examined separately provides limited information about the actual value of the technology. The impact or merit of the technology without knowledge of the potential effect on other resources and associated risks is also quite meaningless.

The strength of this step is that it serves to increase the decision maker's knowledge of the available technology solutions and alternatives. Vendors and salespersons will recommend technologies that range from state-of-the-art to old and proven. Technology advocates from within the organization will often champion a particular technology that they have become convinced sufficiently addresses a particular shortfall or issue. The senior manager should use this step in the model to direct the staff to explore all of the viable technology alternatives. This step intentionally precedes the consideration of available resources because an unconstrained view of alternatives increases creativity.

One weakness of the model is that it does not provide a reference for the number or range of alternatives that a decision maker should consider. The first alternative considered may be sufficient to meet the requirements of the organization. Additionally, there is a cost for collecting information and performing market research. Market research can be broad and time consuming. Or, the research can be abbreviated and address very

specific technologies. The Cost and Impact Tool can assist senior managers in assessing the range of alternatives. A decision maker within an organization may wish to focus on only high impact technologies that will help the organization to assert market leadership in the form of quality or cost. Or, based on resources and organizational design factors, the organization may focus on low-end technologies. The senior leadership must define the scope of the number and type of technologies for consideration.

The project management team for the SHAPE MIS spent a full year conducting research on the various components of the system. The research was very detailed and resulted in a range of technology alternatives. The information technology industry was improving in cycles of less than eighteen months. The project management team often found that items such as routers were improving in even shorter cycles. Eventually a compromise that included alternatives of low end technologies at lower costs and more expensive state-of-the-art technologies was proposed. The final solution combined a high end fiber optics Local Area Network backbone with lower end less expensive workstations. The rationale for this option was based on the expectation that the cost of faster processors for each workstation would decrease and that the high speed backbone would facilitate long-term networking growth throughout the headquarters.

The strategy adopted by the project management team adequately addressed this step in the TADMM. Several technologies ranging from dummy workstations connected to a new mainframe computer to a client-server architecture were analyzed. Although the presentations were technical in their nature, overall strengths and weaknesses for each alternative were presented to the decision maker. This information provided the decision maker with sufficient information to understand the range of available technology options.

### 3. Implementation Resources

Implementation resources addressed in the third step of the TADMM represent the assessment of the resources required to implement and maintain each of the technology alternatives. The decision maker should use this step to explore whether the organization has, and can afford, to divert resources into the technology acquisition. Additionally, the decision maker must make a determination of whether resources, such as personnel, will come from within the organization or from external sources.

Implementation resources go beyond personnel and funding. Time is often a crucial factor in assessing the implementation of a technology. Computer technology still improves in cycles of less than eighteen months. Leap-ahead technologies that take years to implement are no longer state-of the-art when fully functional within the organization.

Completion of the third step of the model provides the decision maker with an assessment of the resource commitments required to implement a new technology. The assessment attempts to quantify such things as, how much training is required, the cost associated with the implementation, personnel requirements and other measurable implementation issues. The third step is included as a filter to eliminate technologies that are entirely outside both the objectives and available resources of the organization.

The strength of this step in the model is that it serves as the first check for eliminating unachievable technologies. Step 2 should be an exercise in creativity on the part of the subordinates and open-mindedness on the part of the decision maker. It is important not to waste resources that are beyond the capabilities of the organization. In order to make a more informed decision, the decision maker must be aware of all of the implementation issues that can be tracked as specific cost centers. As with the other steps

in this model, the decision maker's responsibilities focus on the synthesis and analysis of the information. Subordinates should collect the data and process it into usable and meaningful information. Rough estimates are acceptable in this phase of the process. Steps 5 and 6 will provide additional insight into unexpected costs that will be associated with the new technology. At this point in the model, the decision maker has assembled considerable information about the proposed acquisition. Using the TADMM, the senior manager now has a knowledge of the purpose, alternatives and resource requirements for the acquisition.

Because of a lack of historic documentation related to project decisions, it is difficult to apply this step of the model to the events leading to the acquisition of the SHAPE MIS. The project manager conducted a feasibility analysis under the steps included in the Systems Development Life Cycle Model (SDLC) discussed previously in Chapter III. The SHAPE feasibility analysis focused on an assessment of the adequacy of the technology and the cost of the technology alternatives.

As a management tool, the feasibility analysis provides considerable information to the decision maker. Unfortunately, the feasibility analysis for the SHAPE MIS failed to sufficiently address all of the training resources required for implementation. The program management team invested considerable effort in identifying training resources for the transition to the new system. Training resources included a training facility with several workstations and documentation. However, very little research was directed toward determining the level and amount of training required to adequately support user transition to the new system. The project management team also failed to consider the increased costs associated with transferring data, maintaining the old and new systems and other

software maintenance issues. Because of personnel constraints, maintaining existing systems while trying to implement a new system was extremely taxing on the limited project management and automation staff. The application of the TADMM in this case would have provided a specific step in the decision making process for considering implementation resources.

The strength of this step in the model focuses on the ability to discard unachievable technologies early in the acquisition process. Additionally, the process ensures that the decision maker is aware of some of the additional costs associated with a technology acquisition. Factors such as training existing employees and the potential requirement to hire employees with new or unique skills can significantly add to costs.

#### 4. Organization and Design Factors

The fourth step in the model provides the decision maker the opportunity to assess the current structure and operations of the organization. The Modified Harvard Model provided in Chapter III provides a useful tool for managers to use in making this assessment. The model examines interrelationships between people, work processes, structure and technology, culture, success factors and the internal and external environment. Each area in the model can influence the success or failure of a new technology acquisition. [Ref. 19]

This step in the model is included as a check or opportunity for the decision maker to baseline the current structure and design factors of the organization. For many senior managers this step is a formality that can be accomplished quickly. For others, the actual operating structure may differ from the organizational chart or phone roster. Clearly, there is an expectation that senior managers and decision makers are intimately familiar with the

structure and functions of all of the elements of the organization. However, when committees are used to make decisions about new technology acquisition, each member should have a detailed understanding of the organization.

The strength of this step in the model is that it provides decision makers with current knowledge of both the structure, function and work processes of the various elements and sections within the organization. This step can be a cursory briefing by a deputy or assistant or a detailed briefing by department heads. I favor a detailed briefing because it provides the added benefit of ensuring that functions and objectives are in alignment throughout the organization. The model is flexible enough to allow the decision maker to determine the amount of detail required. Regardless of the amount of information collected, the decision maker must have a sufficient knowledge of the organization's current structure. Understanding the current structure, functions and work processes enables the decision maker to discern the potential effects of change in organization and design factors caused by the technology acquisition.

The obvious weakness in this step is that the onus falls upon the decision maker to determine his or her knowledge of the organization. This step is critical because the decision maker must know the current state to understand the changes that a new technology will bring to the organization. The succeeding step in the model, Organizational Changes, is based on an accurate assessment of the current structure of the organization.

Members of the user group provided an overview of their respective departments to the SHAPE MIS project management team. The information was extremely useful in determining specific hardware and software requirements. The management team and the

members of the user group worked throughout the acquisition process to ensure that any changes in specific functions or structure were well documented. The management team had a detailed organizational chart, a list of personnel within each department and access to each branch and department head. The SHAPE MIS project management team did an excellent job of understanding the current structure of the organization.

**5. Organizational Changes**

An examination of the design factors found within the model may likely lead to the requirement for changes in many of the organization's personnel, processes or technology. Design factors, derived from the Modified Harvard Model, represent those areas over which the senior management within the organization has some level of control. Figure 5-4 provides a graphic depiction of the interaction of the design factors.

SHAPE, at the time of this acquisition, was hierarchical and functionally aligned. Staff officers were assigned to static branches established to address specific staff functions. Members of the project team used their knowledge of the organization's existing structure to assign computer systems to various divisions.

In addition to structure, other organizational design factors are also addressed in this step. At SHAPE, personnel within each branch consisted of NATO civilians, military officers, noncommissioned officers and enlisted personnel. Individuals in each group had a requirement to use the new system. In considering alternatives, education levels and existing work processes should be considered in anticipation of training requirements in view of the technical sophistication of the procured systems.

# ORGANIZATIONAL DESIGN FACTORS

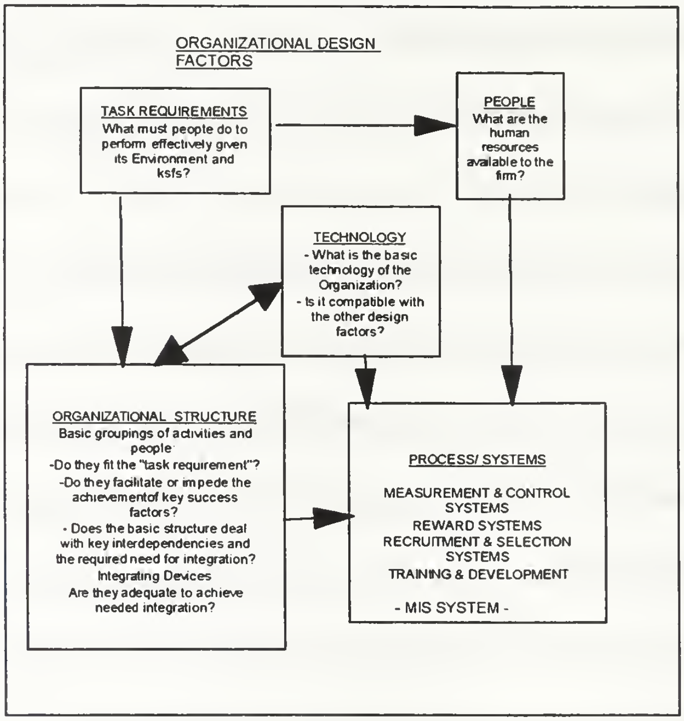


**Figure 5-4**. Organizational Design Factors After [Ref. 19]

All of the variables found in the various design factors and their potential effects must be examined in terms of the goals and objectives of the organization. In some cases, there may be a misalignment in the relationship of the various design factors. The education level of the current personnel may be insufficient for a complicated automated manufacturing system. Or, the processes involved may require a change to the structure and composition of the organization. An automated system may facilitate reduced staffs and virtual groupings of personnel as opposed to a hierarchical or functional structure. Each of these various effects must be evaluated from the context of the introduction of new technologies.

Once the design factors are analyzed, the decision maker must then include the expectation or requirement for those changes into the perceived value of acquiring the new technology. If the technology contributes to the goals of the organization and the amount of change related to the organizational design factors is acceptable, then the new technology should be pursued. This step provides the decision maker with a better understanding of some of the potential unintended effects of acquiring a new technology.

This step in the TADMM provides an assessment of the changes to personnel, organizational structure, work processes and tasks as a result of the technology acquisition. This assessment is the determination of the amount of change that occurs between the baseline established in the fourth step of the model and each of the available alternatives. This step is crucial to facilitating more informed decisions in acquiring technology. Understanding the degree of change can help management and employees to better prepare for the transition to the new technology. If the change is radical, management can help facilitate programs to mitigate the impact of the change. Additionally, the organization's employees can have a better understanding of the impact of the introduction of a new technology.

The strength of this step in the model is that it provides the decision maker with detailed information on the various organizational design factors discussed in the previous chapter. Developing a prototype, role playing or case studies can provide the decision maker with a method of determining the amount of change.

At SHAPE, the introduction of a new system provided more than a faster computer for existing automation tasks. The new system and its software also changed several other processes. As an example, the scheduling of meetings for senior personnel

which included thirty general officers was a laborious time consuming process. Secretaries, administrative assistants and executive officers met weekly to address scheduling conflicts. The use of a networked scheduling system allowed users to check the schedules of potential meeting attendees, send invitations for meetings and block their own schedules for internal meetings. Also the use of e-mail allowed minutes and notes from meetings to be transferred directly to attendees in a timely manner.

In addition to the actual administrative processes, quality control may change. Personnel may be eliminated or new skills may be required. These potential changes can affect user acceptance of the technology acquisition. Individuals concerned about job security may attempt to undermine the implementation of the new system. Or an employee's reliance on old processes may fail to provide the benefits of the new technology acquisition. Senior management's understanding of the potential changes can help to identify required resources, changes in processes and training issues that were omitted in Step 2 of the TADMM.

The weakness of this step in the model is that the decision maker must rely on the information collected in previous steps and have a clear understanding of the current state of the organization. If the baseline knowledge of the structure, functions and processes of the organization are deficient, then the knowledge of the expected changes are also flawed. If senior managers are unaware of the actual processes employed in achieving specific objectives, it is very difficult to accurately estimate the affect of a given technology on an organization. Notwithstanding, there are a number of reasons why the assessment should be attempted.

In technology acquisition, the intended consequences are generally well stated and are instrumental in the final decision on whether to acquire a technology. Occasionally, there are unintended results that have a positive effect on the organization. At SHAPE, the integrated software that was so despised by users also included a form generator. A number of standard forms and documents used throughout the headquarters were developed and distributed. Users were able to fill out forms such as leave requests, personnel actions, security clearances and manual and documentation requests on their systems and e-mail them throughout the headquarters. The use of these forms resulted in time savings and a reduction in paper and reproduction costs. Although the users did not like the MIS software, the forms and form generator were well received. These types of cost savings, process improvements, personnel reductions and quality improvements are often cited as expected and unexpected benefits of a new technology acquisition. However, if the senior managers within the organization do not truly understand the current structure and design factors of the organization, it is impossible for them to understand the potential effects of a technology acquisition.

There was no real assessment of organizational change during the SHAPE MIS acquisition. During the analysis prior to the acquisition, the expected benefits of the technology were discussed in great detail. The only discussion on the change to the organization centered on reduced personnel and the expected increase in productivity. Senior managers had mandated a reduction in the number of support personnel prior to the implementation of the SHAPE MIS. The new technology served as a validation of the senior management's ability to reduce administrative personnel without sacrificing productivity.

### 6. Metrics

The final step of the process, the identification of metrics, provides the decision maker and senior manager a method of measuring the effects of the new technology acquisition. This step is included because a method of measuring effectiveness as well as affect on the organization and its goals and objectives must be developed. Specific measurement techniques are not provided as part of this research. In fact, depending on the technology, each organization and each technology acquisition will have tailored metrics specific to the type of technology and the organization's market. In some cases, metrics have not been developed which provide a clear measurement of the benefit of a particular technology acquisition [Ref. 20: pp. 35-38]. Surveys of recipients of a technology as well as the individuals charged with employment of a technology are a common qualitative measurement vehicle.

Various manufacturing technologies use quantitative productivity measurements over prescribed periods of time to measure the effect of a technology. How many widgets were produced in what increment of time? Or, how many orders were processed in a measurable period of time? Each technique provides some measure of the impact of a new technology [Ref. 4: pp. 47-51]. At SHAPE, the use of qualitative measurements such as ease of use, applicability of software and overall user satisfaction relative to the previous system could have been applied. Quantitatively, network load and usage tracking by a systems administrator could provide a limited indication of productivity. Additionally, senior leadership in each of the divisions could be polled to determine if the quantity and quality of staff work had improved as a result of the new system.

Regardless of the evaluation method, the importance of this stage is that the decision maker must be able to assess the impact of a technology acquisition decision. An ability to measure effects helps to prevent the organization from applying fixes to symptoms and not causes. Potentially, causal relationships may be misinterpreted by the metrics applied to the new technology. However, this process provides an initial consideration of the potential effects prior to the acquisition of the new technology.

## C. CONCLUSION

The TADMM provides decision makers with an enhanced methodology for addressing technology acquisitions. The TADMM is an iterative process that allows decision makers to define and refine issues raised in each of the six steps. Some technology alternatives will be eliminated during one or more iterations of the process. When this occurs, other alternatives can be considered, the organizational design factors can be evaluated or the goals and objectives of the organization can be addressed. The result of the process should provide the decision maker with a more comprehensive knowledge of the technology acquisition alternatives. More importantly, the decision maker will have a more informed perspective on the technology's potential affects on the organization.

# VI. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## A. SUMMARY

The purpose of this research was to examine a case about how senior managers make decisions related to technology acquisition. Also, based on perceived shortfalls discovered in existing management models, a secondary goal of the research effort was to develop a new model that could potentially help future senior managers to make more informed decisions and mitigate the risk associated with technology acquisition. The research provided insight into established decision making models and techniques. Additionally, a new model and methods of decision making were introduced.

Senior managers make numerous decisions about a multitude of various topics. These decisions can be programmed and routine or they can be non-programmed and potentially disruptive. To help facilitate these decisions, senior managers have access to myriad decision making models and problem solving guides. Two general models of decision making were discussed in this research effort. Initially, the Rational Decision Making Model provided insight into prescriptive decision making. Using this model, the decision maker uses a structured process to collect perfect information from which to make a decision. The Behavioral Decision Making Model represents the second model discussed in this research. This model acknowledges that decision makers often make decisions with limited and biased information. As a result, decision makers choose to accept less than optimal solutions. Both models provide a useful methodology for managers involved in making decisions. However, additional research introduced a potentially more comprehensive theory on decision making.

The Technology Acquisition Decision Model (TADMM) was developed from an analysis of existing decision making approaches and the Modified Harvard Model. The new model incorporates an understanding of various organizational design factors into a structured decision making process. The new model helps the manager to view not only the technology acquisition but also the interrelationships between the technology and the other components that make up the organization.

The TADMM also introduces a tool for comparing risk based on the cost and the impact associated with the new technology. Each step within the TADMM is presented and discussed in detail. Additionally, the SHAPE case study was used to analyze the strengths and weaknesses of the new decision making model and to address the specific research questions.

## B. CONCLUSIONS

The research objectives focused on senior managers' decisions related to technology acquisition. In addition to the mechanics or process, the research provided insight into the decision making models used in technology acquisition and other decisions related to an organization. The principle conclusions from the research and the answers to the stated research questions are presented below.

### 1. Primary Research Question

How do managers make decisions related to the acquisition of technology?

a. How do managers conduct needs assessments?

b. How do decision makers select technology that is appropriate for the organization?

c. How do senior managers anticipate the various effects of a given technology on the components of an organization?

The results of this research indicate that in the SHAPE MIS case, decision makers employed a rational decision making methodology to address their technology acquisition. The senior managers employed the Systems Development Life Cycle Model (SDLC) to facilitate decisions related to the acquisition. Analysis of the results of the case indicate that users of the model failed to accurately identify required resources or potential effects of the acquisition. Some of the identified shortfalls were potentially a result of poor implementation of the SDLC. However, there were a significant number of issues that could also be attributed to the model. Using the methodology established by the SDLC, alternatives were collected and presented to the decision makers based on a cost-benefit analysis. Decisions were based on how well specific alternatives met the stated requirements within the given resource constraints.

At SHAPE, senior managers assessed technology needs by establishing a users group with a charter to identify technology requirements. Like SHAPE, the employment of users groups or standing committees is a standard practice found in many organizations. Once a set of requirements were established, a project management team with technology specialists was organized and tasked with collecting specific information and alternatives to present to the decision maker.

Often a direct user surfaces the need for the technology based on a specific problem that can be solved by the acquisition of a very specific technology. The technology acquisition is then linked to a very specific requirement. At SHAPE the need for technology that improved various staff processes such as archiving and retrieving data,

distributing information and reducing personnel drove the requirement process. The issue for the senior manager was well defined and could be addressed by answering a series of detailed questions. Is the need for the requirement real? Will the technology solve the problem? Is the cost of the technology commensurate with the available resources? The very nature of the questions lend themselves to the decision maker making singularly quantitative assessments of the costs and benefits associated with a technology acquisition.

The SHAPE case indicates that little consideration was given to potential positive or negative effects outside of the planned benefits of the implementation of the new MIS. This research did not collect enough information to state that this lack of consideration is consistent in all technology acquisitions. However, my experience in similar situations indicates that the SHAPE case illustrates a trend in how many senior managers fail to anticipate the effects of technology acquisition. There are several reasons why senior managers do not anticipate the effects of a technology acquisition.

Consideration of the long term effects of the technology acquisition can be secondary to concerns about cost and short term benefits. The senior manager relies on the technology advocate for determining the best technology solution and upon the financial management staff for identifying cost and resource issues. Human resources and other organizational issues are potentially viewed as secondary issues that can be addressed during the implementation process. The technology advocate or committee charged with determining technology solutions provide the senior manager with alternatives that may or may not incorporate anticipated effects. At SHAPE, the project manager employed the System Development Lifecycle Model. However, the project manager focused on providing the decision maker with only the technology and cost

advantages and disadvantages of each alternative. The emphasis was not on anticipating the various affects of the technology on other components of the organization. Staff members make operational level decisions involving technology.

Senior managers are responsible for analyzing technology from a strategic point of view. A failure to consider the impacts that a new technology may have on an organization is the responsibility of the senior manager and not the staff tasked to implement the technology.

### 2. Secondary Research Question

Can a more comprehensive model be developed that assists senior managers and improves decision making in the acquisition of technology?

The Technology Acquisition Decision Making Model (TADMM) represents an attempt to develop a model to improve decision making in the acquisition of technology. The shortfalls identified in the SDLC focus on the lack of a comprehensive assessment of the effects of a technology acquisition. To address these shortfalls, the TADMM provides the decision maker a structured methodology that incorporates the organizational design factors found in the Modified Harvard Model into the technology acquisition process.

The SHAPE case provides several examples of how a more comprehensive model can improve the acquisition process. User satisfaction issues such as training could have been addressed by employing an assessment of the Organization and Design Factors and the Metrics steps of the TADMM. In addition to training issues, personnel issues and data transfer problems could have been identified by an assessment of the organizational changes described in Step 5 of the new model.

The development of a new model represents only the first step in assisting senior managers to make more informed decisions regarding technology acquisitions. The SHAPE case illustrates a scenario where an existing decision making model failed to address all of the issues that contribute to the success or failure of a technology acquisition. The TADMM provides steps and a risk assessment tool to help decision makers. Only the application of the TADMM to several technology acquisitions can determine whether the tool is better than existing decision making models.

## C. RECOMMENDATIONS FOR FURTHER STUDY

1. The Technology Acquisition Decision Making Model (TADMM) represents a theoretical application of old and new management principles. The TADMM should be applied by decision makers to a range of actual technology acquisitions to determine its effectiveness. Each of the six steps in the model should be analyzed individually and as part of the overall decision making model to determine their applicability to the technology acquisition process.

2. A comprehensive survey of senior managers within commercial organizations should be conducted to gain insight into decision making related to technology acquisition. Additionally, senior managers within Department of Defense (DoD) organizations should also be surveyed. A study of this nature will indicate if there are significant differences involving technology decision making between public and private managers.

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